

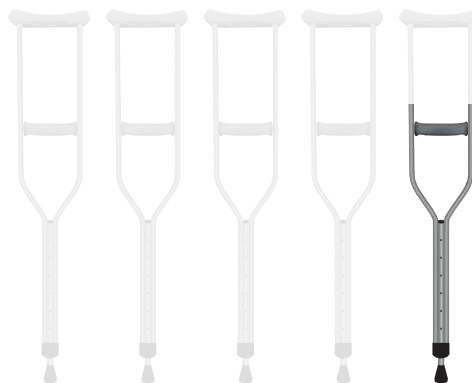


Foot assessment in patients with diabetes mellitus



Objective	Scope	Target audience
To enhance identification and management of risk for developing diabetic foot ulcers (DFU) in patients with diabetes mellitus	Foot assessment, risk stratification, and patient education	This clinical guidance is relevant to all healthcare professionals caring for patients with diabetes mellitus, especially the main providers of primary or generalist diabetes care

Diabetes mellitus is a major global health concern. It is associated with macro- and microvascular complications, including DFU. DFU precede about 85% of lower extremity amputations¹ and are associated with mobility loss, poorer quality of life, and decreased overall productivity.² In Singapore, almost five lower extremity amputations occur every day on average in patients with diabetes mellitus.³ Regular foot assessment is recommended to identify and manage the risk of developing DFU, with the frequency of assessment depending on patient's risk category.⁴⁻¹¹



In Singapore, almost five amputations occur every day on average in patients with diabetes mellitus.

About **85%** of amputations could be avoided through regular foot assessment.

Statement of Intent

This ACE Clinical Guidance (ACG) provides concise, evidence-based recommendations and serves as a common starting point nationally for clinical decision-making. It is underpinned by a wide array of considerations contextualised to Singapore, based on best available evidence at the time of development. The ACG is not exhaustive of the subject matter and does not replace clinical judgement. The recommendations in the ACG are not mandatory, and the responsibility for making decisions appropriate to the circumstances of the individual patient remains at all times with the healthcare professional.

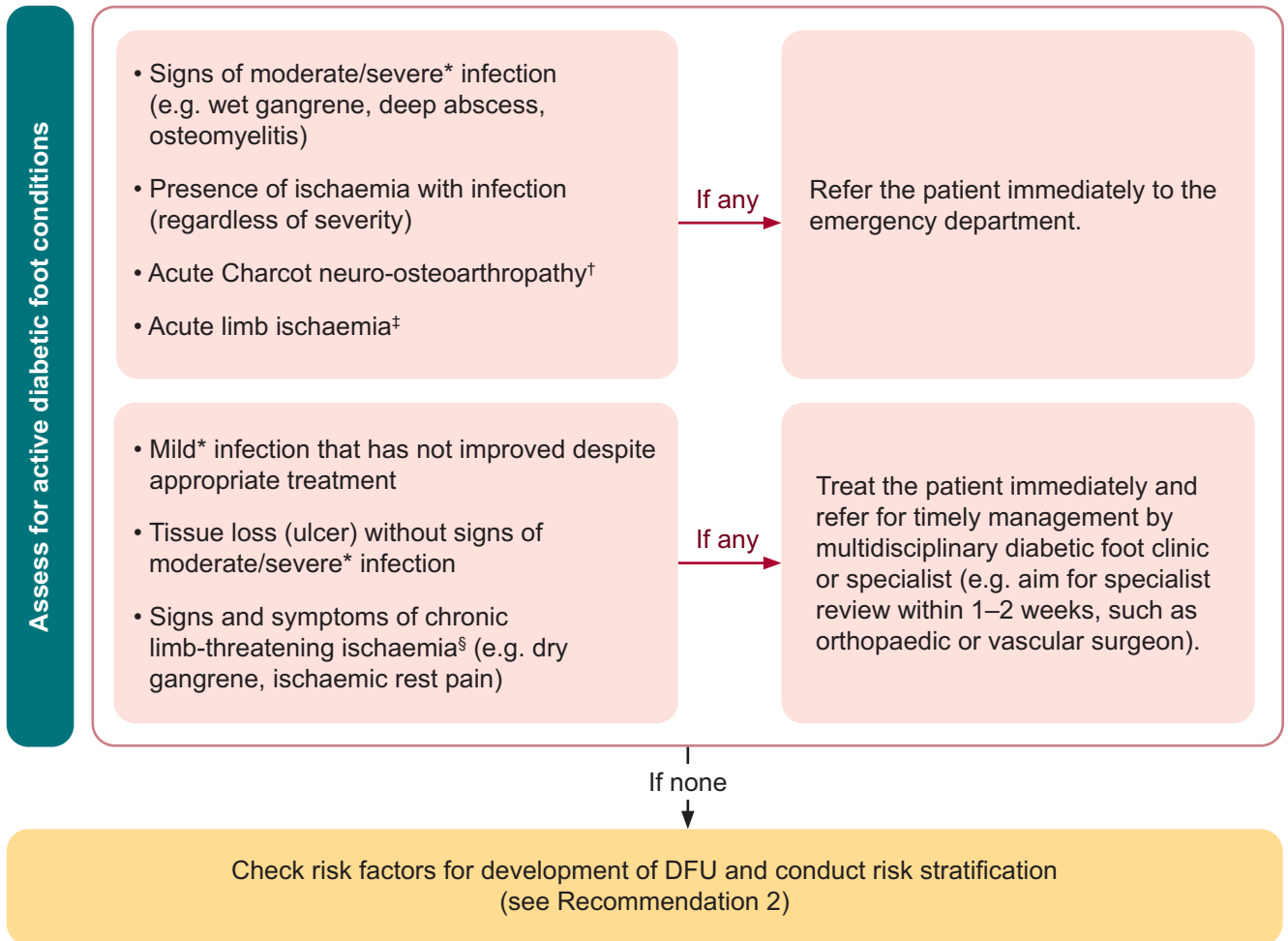
Foot assessment

Recommendation 1

Check for presence of active diabetic foot conditions in all patients with diabetes mellitus.

Foot assessment for patients with diabetes mellitus begins with checking for presence of active diabetic foot conditions, such as infection, acute Charcot neuro-osteoarthropathy, or limb ischaemia. **If present, immediate treatment or referral may be warranted** depending on the type of condition identified (see Figure 1 below). In patients without active diabetic foot conditions, assess the patient's risk of developing DFU and stratify accordingly (see Recommendation 2).

Figure 1. Active diabetic foot presentation and management



DFU, diabetic foot ulcers

* See [Supplementary table 1](#) on IWGDF/IDSA classification system for presence and severity of infection¹²

† Characteristics include: unilateral unexplained red hot swollen foot, numbness, changes in the midfoot (e.g. rocker-bottom deformity), X-ray findings (e.g. midfoot collapse, joint destruction, joint subluxation, or malalignment), possible history of overloading or trauma. Differential diagnoses (e.g. infection, gout, deep vein thrombosis, fractures or sprains) should also be excluded.

‡ Acute limb ischaemia: severe limb hypoperfusion with onset <2 weeks, characterised by features like pain, pallor, pulselessness, poikilothermia (cold), paresthesias, or paralysis¹³

§ Chronic limb-threatening ischaemia: objectively documented atherosclerotic peripheral arterial disease in association with ischaemic rest pain or tissue loss (ulceration or gangrene) for at least 2 weeks¹⁴

Recommendation 2

Use foot assessment findings to determine the risk of developing a diabetic foot ulcer, corresponding review frequency, and need for referral.

A comprehensive foot assessment includes medical history, physical examination of the feet (including tests), symptoms assessment, and review of other risk factors for the development of DFU. Foot assessment findings are used to categorise a patient's risk of developing DFU and inform risk-based management decisions, such as referral and frequency of review.

Risk stratification

Assess patients without active diabetic foot conditions for factors that increase their risk of developing DFU and manage according to their assigned risk category.

Factors used for stratifying risk of developing DFU are:⁴⁻¹¹

- Previous foot ulcer or amputation
- Estimated glomerular filtration rate persistently <15 ml/min/1.73m² over at least three months (including patients on dialysis)
- Clinical findings (including objective tests) of:
 - Callus
 - Deformity
 - Peripheral arterial disease (PAD)
 - Neuropathy

See Figure 2 for details of factors contributing to risk stratification, risk categories for the development of DFU, and associated actions (e.g. review frequency). Figure 3 summarises the steps involved in conducting a foot examination and performing main objective tests.



Practice point

If any of the factors contributing to risk of developing DFU cannot be assessed reliably to inform risk stratification, assume the risk factor to be present.

Example: a patient with cognitive impairment who is unable to engage in objective tests for neuropathy can be assumed to have the neuropathy risk factor for risk stratification.

Other factors of foot assessment

While not directly contributing to risk stratification, other factors inform overall management needs, referral requirements, and patient education. These include:

- Glycaemic control
- Smoking
- Foot care and footwear
- Skin integrity (e.g. corns, callus requiring intervention, blisters)
- Toenail condition (e.g. ingrown toenail, moderate fungal nail)
- Lacking caregiver support or inability to self-care (e.g. significant arthritis, cognitive or visual impairment, inability to maintain personal hygiene or self-check feet for problems)



Importance of comprehensive management

Foot assessment is only one component of diabetes management and its associated conditions (refer to [type 2 diabetes mellitus management ACG](#)). For example, patients with PAD require comprehensive cardiovascular management including optimisation of glycaemic control, blood pressure (refer to [hypertension ACG](#)), and lipid profile (refer to [lipid management ACG](#)), smoking cessation (if applicable), and initiation of antiplatelet therapy, if indicated.

ACGs on other areas of diabetes management and relevant associated conditions can be found [here](#) under "Related ACGs".

Referral

Referral to specialists, podiatrists, or other healthcare professionals may be required based on findings from foot assessment. Patients who are stratified to be at moderate or high risk of developing a DFU could be referred **if additional assessment or intervention is needed**.

Patients lacking self-care ability (e.g. significant arthritis, cognitive or visual impairment, inability to maintain personal hygiene or self-check feet for problems) or have limited/absent caregiver support may require referral to relevant services (e.g. primary care nursing, podiatry or social services) where available.

Additional considerations for referral are:

Clinical findings	Referral speciality
<p>Deformity</p> <ul style="list-style-type: none"> • Pain or functional impairment due to significant deformity • Charcot neuro-osteoarthropathy as suggested by clinical or X-ray findings (e.g. midfoot collapse, joint destruction, joint subluxation, or malalignment) 	Consider referring to orthopaedics**
<p>PAD</p> <ul style="list-style-type: none"> • Clinical findings that may benefit from further assessment or vascular intervention, comprising of: <ul style="list-style-type: none"> - Objective tests (e.g. TBPI or ABPI) - Symptoms (e.g. vascular claudication, ischaemic rest pain, ulcer) 	Consider referring to vascular especially if symptomatic**
<p>Neuropathy</p> <ul style="list-style-type: none"> • Severe or worsening symptoms (e.g. pain despite appropriate analgesia) in typical diabetic neuropathy • Atypical features suggesting non-diabetic neuropathy or atypical forms of diabetic neuropathy (e.g. acute onset, asymmetrical distribution, motor deficits worse than sensory deficits, or non-length dependent features such as involvement of both hands and feet at the same time or hands prior to involvement of feet¹⁵) 	Consider referring to neurology**
<p>Skin/nails</p> <ul style="list-style-type: none"> • Pre-ulcerative skin lesion (e.g. corn or callus requiring podiatric treatment, blister or fissure, tinea pedis) • Pathological toenail (e.g. ingrown toenail, moderate fungal nail) 	Assess need for podiatry referral ^{††}

** Can be guided by referral pathways to the relevant specialties or services as per institution protocols, where available

†† Low-risk or stable skin and toenail conditions of the foot may not need referral to podiatry. Please see "Podiatry referral criteria" developed as part of the HealthierSG care protocol on diabetes mellitus for more details (see [Diabetes Mellitus HealthierSG care protocol](#)) or scan QR code on the right.

Scan the QR code to the right for podiatry referral criteria in the diabetes mellitus HealthierSG care protocol



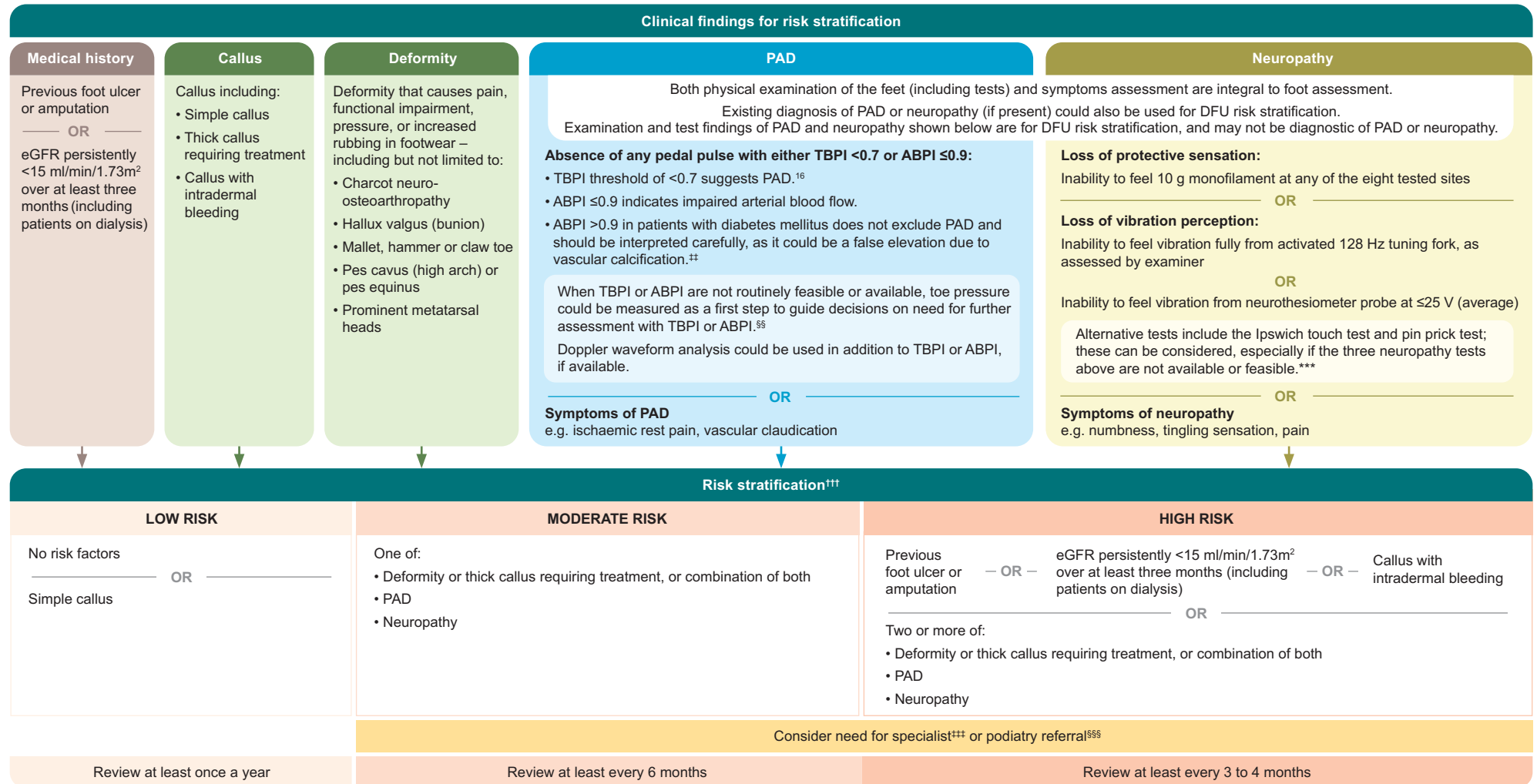
Review

Conduct comprehensive foot assessment **at least once a year for all patients** with diabetes mellitus. Carry out **more frequent review for patients in the moderate-risk** (every six months) **and high-risk categories** (every three to four months), focusing the assessment on factors that contributed to that risk classification. For example, for a patient with a moderate risk of developing DFU because of thick callus requiring treatment, review after six months for any change in status of callus and then again at one year for a comprehensive foot assessment.

Each review is also an opportunity for the healthcare professional providing care at that point (e.g. nurse, doctor, or podiatrist) to:

- Visually inspect the feet for any visible lesion
- Check on the patient's understanding of good practices (see Recommendation 3), and
- Reinforce the importance of foot care and appropriate footwear (see Recommendation 3)

Figure 2. Risk stratification based on clinical findings from foot assessment in patients with diabetes mellitus (For features of active diabetic foot conditions, see Figure 1)



ABPI, ankle-brachial pressure index; eGFR, estimated glomerular filtration rate; PAD, peripheral arterial disease; TBPI, toe-brachial pressure index

^{††} Medial artery calcification is likely in ABPI >1.3 and if co-existent with PAD may result in ABPI within the normal range of 0.9 to 1.3.

^{§§} For example, TBPI or ABPI could be conducted for patients with a toe pressure of <100 mmHg based on a local study.¹⁶ However, evidence supporting the use of toe pressure alone as PAD test is limited and accuracy of toe pressure may be affected by other factors including white coat effect or dialysis.¹⁷

^{***} While the Ipswich touch test does not require any equipment, is simple to conduct, and has comparable agreement with standard tests in detection of neuropathy, studies that show usefulness in predicting foot ulcer or amputation are lacking.¹⁸ Loss of protective sensation is likely when light touch is not sensed in 2 or more sites. Limited studies are available on the usefulness of pin prick test in diagnosis of diabetic neuropathy.^{19,20}

^{†††} A Diabetic Foot Screening Risk Calculator is also available as part of the HealthierSG care protocol on diabetes mellitus (see [Diabetic Foot Screening Risk Calculator](#) or scan QR code on the right).

^{†††} Can be guided by referral pathways to the relevant specialties or services as per institution protocols, where available

^{§§§} Low-risk or stable skin and toenail conditions of the foot may not need referral to podiatry. Please see "Podiatry referral criteria" developed as part of the HealthierSG care protocol on diabetes mellitus for more details (see [Diabetes Mellitus HealthierSG care protocol](#) or scan QR code on the far right).

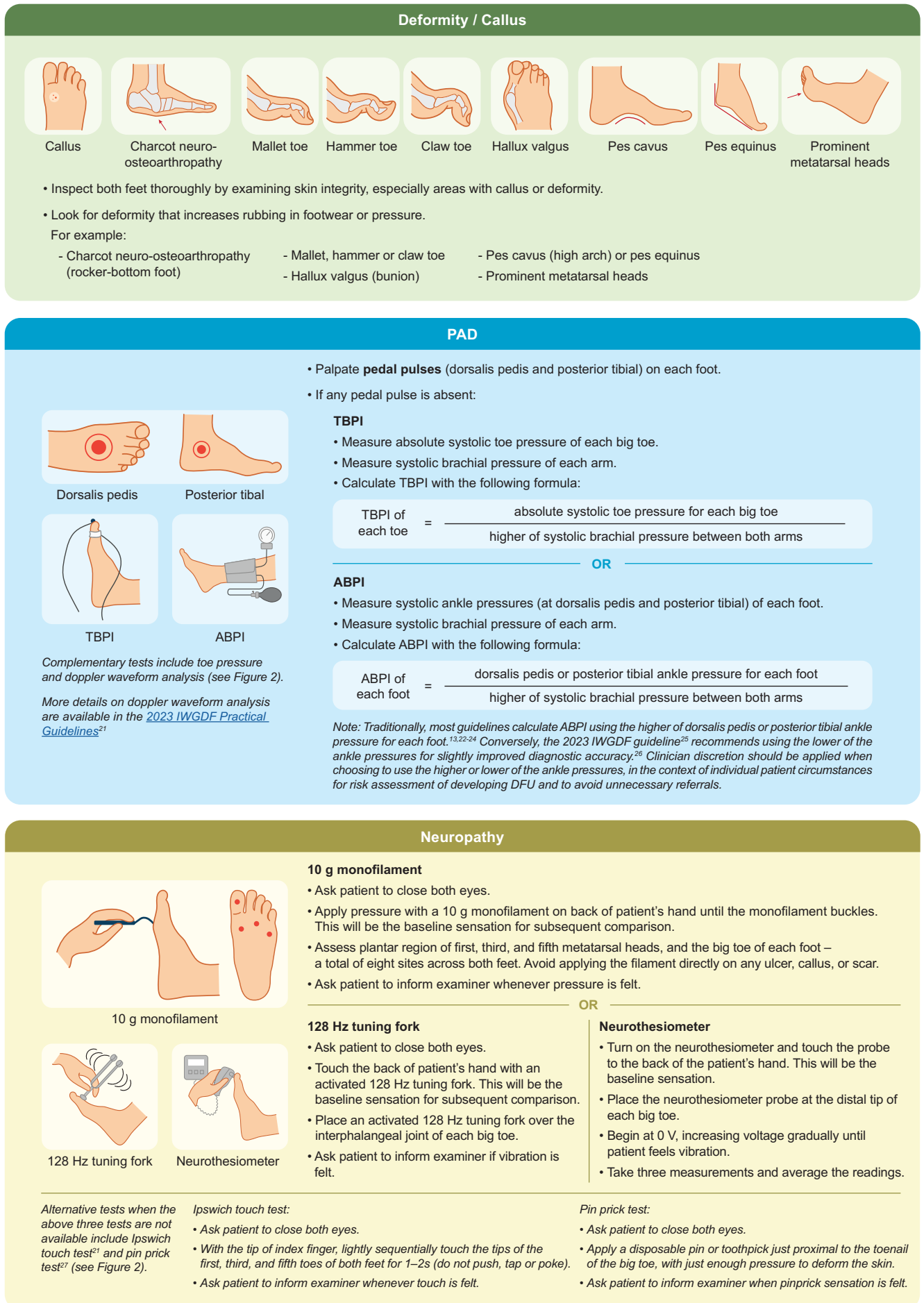
Scan the QR code below for Diabetic Foot Screening Risk Calculator



Scan the QR code below for podiatry referral criteria in the diabetes mellitus HealthierSG care protocol



Figure 3. Foot examination and main objective tests for risk stratification



Patient education

Recommendation 3

Educate all patients with diabetes mellitus regularly on lifestyle, regular foot assessment, foot care and appropriate footwear, to reduce risk of developing diabetic foot ulcers.

Advise patients on sustained lifestyle interventions to maintain optimal glycaemic control, such as eating a healthy balanced diet, maintaining a healthy weight, exercising regularly and quitting smoking (smoking increases lower extremity amputation risk by 40% in people with diabetes mellitus²⁸). For more details, please refer to the ACG [“Type 2 diabetes mellitus – personalising management with non-insulin medications”](#). Patients who require more comprehensive support for lifestyle modifications may also be referred to other resources or healthcare professionals for multidisciplinary care, as appropriate.

Regularly educate patients on the importance of good foot care and appropriate footwear (see Figure 4), in addition to their risk stratification result and recommended follow up frequency.

Figure 4. Patient education aid on foot care and footwear

This is a general guide designed to complement, and not replace, education or advice provided by a healthcare professional; tailor advice to the individual patient's needs.

Foot care education

Check feet every day

Use a mirror or selfie stick or ask for help if you can't see the bottom of your feet.

Look out for:

- Blister, wound, corn, callus, or toenail abnormality
- Redness, swelling, bruise, or increased warmth

Wear well-fitting and covered footwear

- Avoid walking barefoot or in socks without shoes, even at home; wear home sandals with non-slip soles.
- Try on new shoes while standing and at the end of the day when feet tend to be largest.
- Wear well-fitting covered shoes with socks.
- Check and remove any stones or sharp objects inside shoes before wearing them.

Maintain good foot care and hygiene

- Clean feet daily with mild soap and water.
- Dry thoroughly between each toe.
- Avoid using harsh soap, massaging with hot oil or soaking feet for prolonged periods.
- Avoid cutting nails too short; cut them straight across and file corners.
- Avoid using any sharp tools on your feet. Use a pumice stone or foot file to gently remove hard skin; do not over-file (check the area regularly after every few strokes of filing).

Apply simple first aid to small wounds

- Clean the small wound with saline or clean water before applying antiseptic and covering with a plaster.
- Seek medical help if there is no improvement after two days or if there are signs of infection.



Moisturise feet regularly

- Apply moisturiser daily but not between toes.
- Avoid scratching skin as it may lead to wound or bleeding.

Seek medical help early if wound is not healing well, or worsens

If signs of infection are present, such as redness, swelling, increased pain, pus, fever, or the wound starts to smell, seek medical help as soon as possible.

Footwear education

Soft cushioning inner sole

For better comfort

Firm back (heel counter)

Low heel

Adjustable ankle fastening (lace or velcro)

To hold feet in place and reduce rubbing within shoes

Soft and breathable materials

To prevent too much moisture within shoes

Appropriate sizing of foot wear, deep and wide toe box

- To let toes wiggle freely
- Make sure shoes are broad enough for widest part of feet and any deformities
- Make sure appropriate length (one-thumb width between toes and tip of the shoes)

Firm at back and middle sections of the sole

To support middle part of the foot (arch)

Flexible at front section of the sole

To allow natural movement of toes when walking



References

Click or scan the QR code for the reference list to this clinical guidance



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About the Agency

The Agency for Care Effectiveness (ACE) was established by the Ministry of Health (Singapore) to drive better decision-making in healthcare by conducting health technology assessments (HTA), publishing healthcare guidance and providing education. ACE develops ACE Clinical Guidances (ACGs) to inform specific areas of clinical practice. ACGs are usually reviewed around five years after publication, or earlier, if new evidence emerges that requires substantive changes to the recommendations. To access this ACG online, along with other ACGs published to date, please visit www.ace-hta.gov.sg/acg

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Supplementary Table 1. IWGDF/IDSA classification of presence and severity of infection of the foot in a patient with diabetes mellitus****12

Clinical classification of infection, definitions	IWGDF/IDSA classification
No systemic or local symptoms or signs of infection	1 / Uninfected
<p>Infected: at least two of these items are present:</p> <ul style="list-style-type: none"> • Local swelling or induration • Erythema >0.5 but <2 cm^{†††} around the wound • Local tenderness or pain • Local increased warmth • Purulent discharge <p>And, no other cause of an inflammatory response of the skin (e.g. trauma, gout, acute Charcot neuro-arthropathy, fracture, thrombosis, or venous stasis)</p>	2 / Mild
<p>Infection with no systemic manifestations and involving:</p> <ul style="list-style-type: none"> • Erythema extending ≥ 2 cm^{†††} from the wound margin, and/or • Tissue deeper than skin and subcutaneous tissues (e.g. tendon, muscle, joint, and bone) 	3 / Moderate
Infection involving bone (osteomyelitis ^{††††})	Add "(O)"
<p>Any foot infection with associated systemic manifestations (of the systemic inflammatory response syndrome [SIRS]), as manifested by ≥ 2 of the following:</p> <ul style="list-style-type: none"> • Temperature, >38 °C or <36 °C • Heart rate, >90 beats/min • Respiratory rate, >20 breaths/min, or PaCO₂ <4.3 kPa (32 mmHg) • White blood cell count >12,000/mm³, or <4 G/L, or >10% immature (band) forms 	4 / Severe
Infection involving bone (osteomyelitis ^{††††})	Add "(O)"

Note: The presence of clinically significant foot ischaemia makes both diagnosis and treatment of infection considerably more difficult.

**** Infection refers to any part of the foot, not just of a wound or an ulcer.

††† In any direction, from the rim of the wound.

†††† If osteomyelitis is demonstrated in the absence of ≥ 2 signs/symptoms of local or systemic inflammation, classify the foot as either grade 3(O) if <2 SIRS criteria, or grade 4(O) if ≥ 2 SIRS criteria.